CORRESPONDENCE

A Template for Rapid Recomputation of Upper Air Soundings

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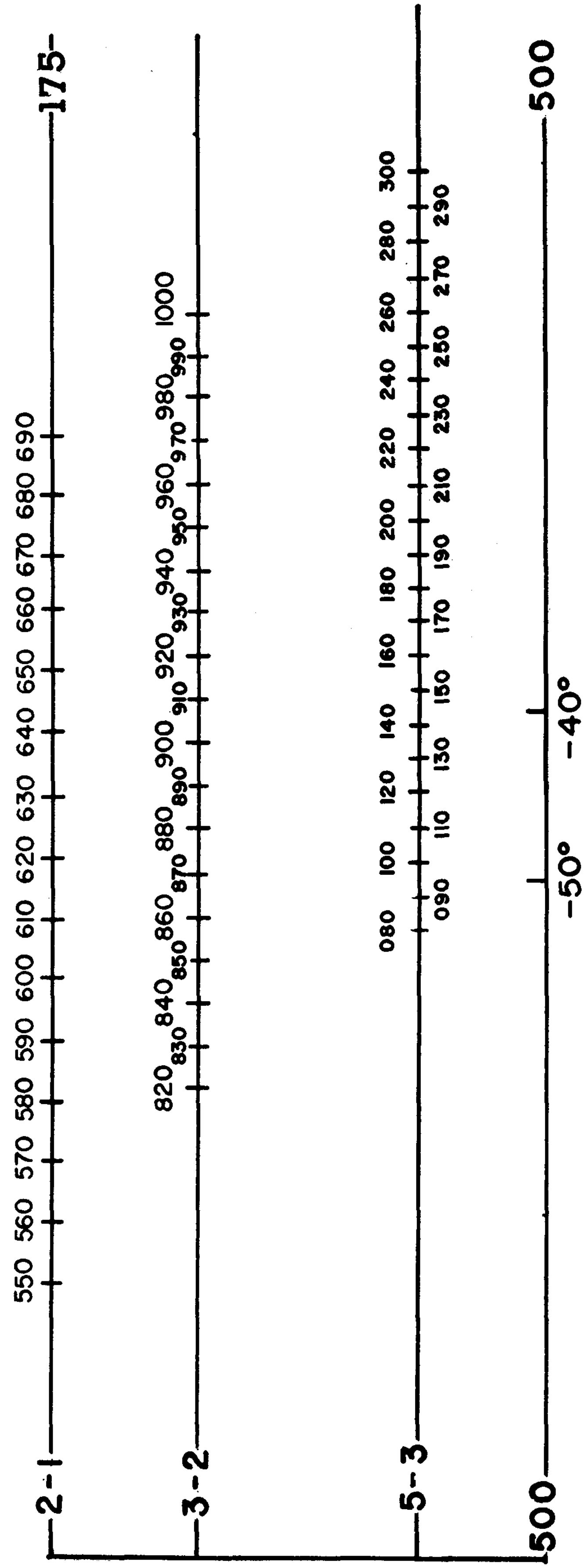
In March 1955, the National Weather Analysis Center (NAWAC) increased the area of analysis and prognosis to include the entire Northern Hemisphere. As a result a multitude of upper-air reports must be recomputed as quickly and accurately as possible. The template reprinted here (fig. 1) was designed and adopted for use in NAWAC to expedite the checking of soundings by employing the hydrostatic relationship of layer thicknesses to mean virtual temperatures. Meteorologists at stations or centers receiving many upper-air soundings that require the recomputing of data may find this template useful. It may be reproduced directly from figure 1 as the original size to fit pseudoadiabatic chart (WB Form 770-10) has been preserved.

Reference temperatures (0°, −50°, −40° C.) and pressures (1050, 400, 500, and 175 mb.) have been marked to facilitate the alignment of the template over the pseudo-adiabatic chart. The scales marked off along horizontal lines give the thickness values (tens of ft.) for the layers that are identified by the numbers at the left ends of the lines (1-8 is 1000-850 mb; 8-7, 850-700 mb.; 7-5, 700-500 mb., etc.). The small positive temperature values (° C.) covering the ranges indicated by arrows between selected constant mixing ratio lines (dashed, gm./kg.) are corrections to be applied to the mean temperature of the layers to obtain the mean virtual temperature. It may be noted that these corrections are approximately $w/6$. Thus, $T_v \cong T_m + (w/6)$, where T_v is mean virtual temperature (° C.), T_m is the mean temperature (° C.) of the layer, and w is the mixing ratio (gm./kg.).

The template is used as follows: Superimpose the template on the pseudo-adiabatic chart (WB Form 770-10) on which the temperature and dewpoint soundings have been plotted. The intersection of the plotted temperature curve with a horizontal line on the template gives a close approximation to the mean temperature of the corresponding layer. Similarly the intersection of the plotted dewpoint curve with the horizontal line on the template gives the approximate mean mixing ratio of the layer. The temperature correction corresponding to the interval (dashed lines) in which this mean mixing ratio falls is read from the template and added to the mean temperature to obtain the mean virtual temperature. The latter value determines a point on the horizontal scale of the template from which the thickness value for the layer is read. The height of successive pressure surfaces is obtained in the usual way by accumulating the thickness values, starting with the height of the 1000-mb. surface. The 1,000-mb. height, of course, is readily obtained by any



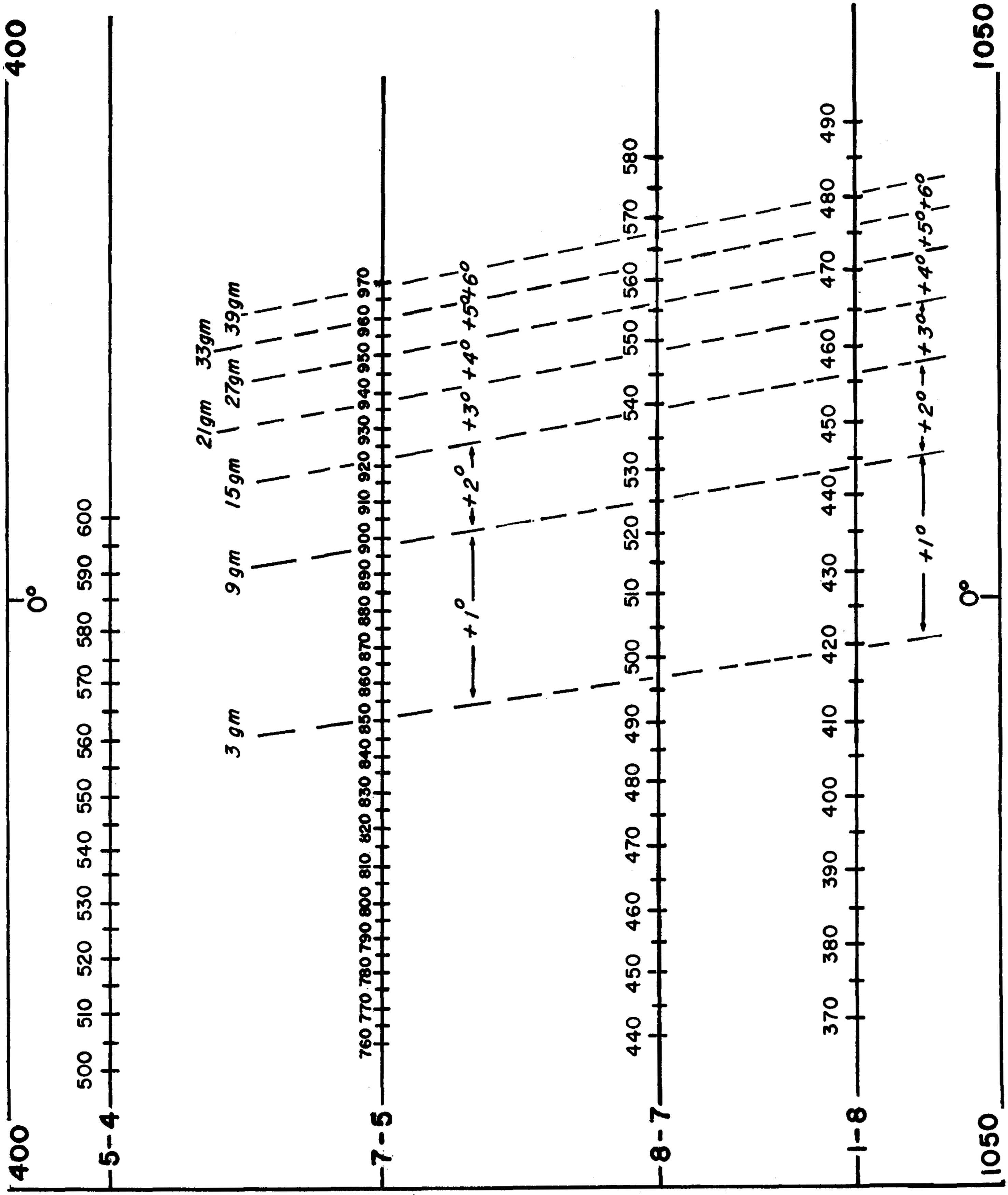


FIGURE 1.—Template for rapid recomputation of soundings plotted on pseudo-adiabatic chart (WB Form 770–10). The portion above corresponds to the lower half of the chart (1050 to 400 mb.); the portion on the preceding page corresponds to the 500 to 175 mb. interval of the upper half of the chart.

of the well known methods using surface or sea level pressure and air temperature (e. g., nomogram on Skew T—log p Diagram (AWS Weather Plotting Chart 9–16) see pp. 23–25, *Air Weather Service Manual* 105–124, Sept. 1952).

When the lapse rate is irregular within a layer, the mean temperature should be adjusted to obtain a more representative temperature. This is accomplished by taking the mean temperature such that the total area to the right of the temperature line and bounded by it, by the lapse rate curve, and by the upper and lower pressure lines, is equal to the area similarly bounded to the left of the temperature line.

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Comparison of Monthly Mean Geostrophic and Resultant Wind Speeds

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Since January 1950 a discussion of the weather and circulation of each month has been published regularly in the *Monthly Weather Review* [1]. In the preparation of these articles it has become customary to use charts showing the geographical distribution of monthly mean geostrophic wind speeds, with jet axes superimposed, at either the 700-mb. level (since Nov. 1950 [2]) or the 200 mb. level (since July 1952 [3]). Because many studies have recently been made on the fine-grained structure of the wind field in the vicinity of the jet stream on a synoptic basis, some misunderstanding has arisen about the nature and scale of the mean jet axes portrayed in this series. It is the purpose of this note to explain the method of preparing the charts used to depict mean wind speeds and, in particular, to compare the geostrophic wind speed with resultant wind speeds for the month of June 1957, about which some question has been raised. (Wind direction will not be considered.)

The basic data for upper-level heights are obtained from daily hemispheric synoptic charts, at the 700-mb. level from both 0000 GMT and 1200 GMT maps analyzed within the Extended Forecast Section, and at the 200-mb. level from 0000 GMT maps analyzed in the National Weather Analysis Center. By interpolation from the contours on these maps heights are read each day at standard intersections of latitude and longitude arranged in the shape of a diamond grid. The network of points actually used is illustrated by the location of the contour heights plotted in parentheses in figure 1. After the heights are read they are entered on punched cards, from which means of various durations are readily computed.

Wind speeds are obtained indirectly from the mean heights by use of the geostrophic assumption. For convenience these geostrophic wind speeds are computed directly from the heights at standard intersections at points midway between these intersections. To facilitate this phase of the work special tables have been prepared [4] which give the total horizontal geostrophic wind speed at points along each 5° of latitude from 15° N. to 85° N. as a function of the difference in height between points 5° of latitude to the north and south and 5° of longitude to the east and west. The locations of the points at which winds are computed are shown by the speeds plotted in figure 1. For example, the wind speed of 29 knots at 40° N., 65° W. (off Nantucket) was computed from the four surrounding mean heights: namely, 39,800 ft. at 45° N., 65° W.; 40,300 ft. at 35° N., 65° W. (giving a height difference of 500 ft. in the north-south direction); 40,100 ft. at 40° N., 60° W.; and 40,200 ft. at 40° N., 70° W. (giving a height difference of 100 ft. in the east-west direction).

In this way mean wind speeds are quickly obtained over all portions of the Northern Hemisphere. These speeds are generally easy to analyze in the form of a smooth isotach pattern which is designed to reflect only the large-scale or planetary features of the wind field. Despite the fact that the speeds are computed from height differences taken across a relatively large distance (10° of latitude by 10° of longitude), one or two axes of maximum wind speed (or jet streams) are nearly always well delineated, not only at the 200-mb. but also at the 700-mb. level. These jets axes usually parallel the mean contours and meander across a large part of the hemisphere. Analysis of the variations of the jet stream from place to place and from month to month has proven very helpful in interpreting changes in the observed weather.

Comparison of the monthly mean geostrophic winds computed as described above with the monthly resultant winds computed at observing stations is of considerable interest. An organized study of this problem was conducted in 1951 by Aubert and Winston [5], who found good correspondence between monthly mean geostrophic and resultant winds in the United States, but for the 700-mb. rather than the 200-mb. level. In the present case some differences are to be expected, however, because although both winds have been averaged with respect to time, only the geostrophic winds have been averaged with respect to space (10° lat. by 10° long.). Better agreement could probably be obtained by computing height differences for the geostrophic winds over a shorter distance than 10°. Additional smoothing has been introduced into the geostrophic winds by virtue of the fact that they are based on analyzed contours rather than on individual station data. Further differences may be expected because of systematic non-geostrophic wind components and all sorts of instrumental and experimental errors inherent in the resultant winds. It should also be noted that observed winds are not always available at all stations. For instance, the resultant wind data for June 1957 [6] contain from 1 to 3 missing days at no less than 20 stations out of 67 reporting at the 200-mb. level in the United States.

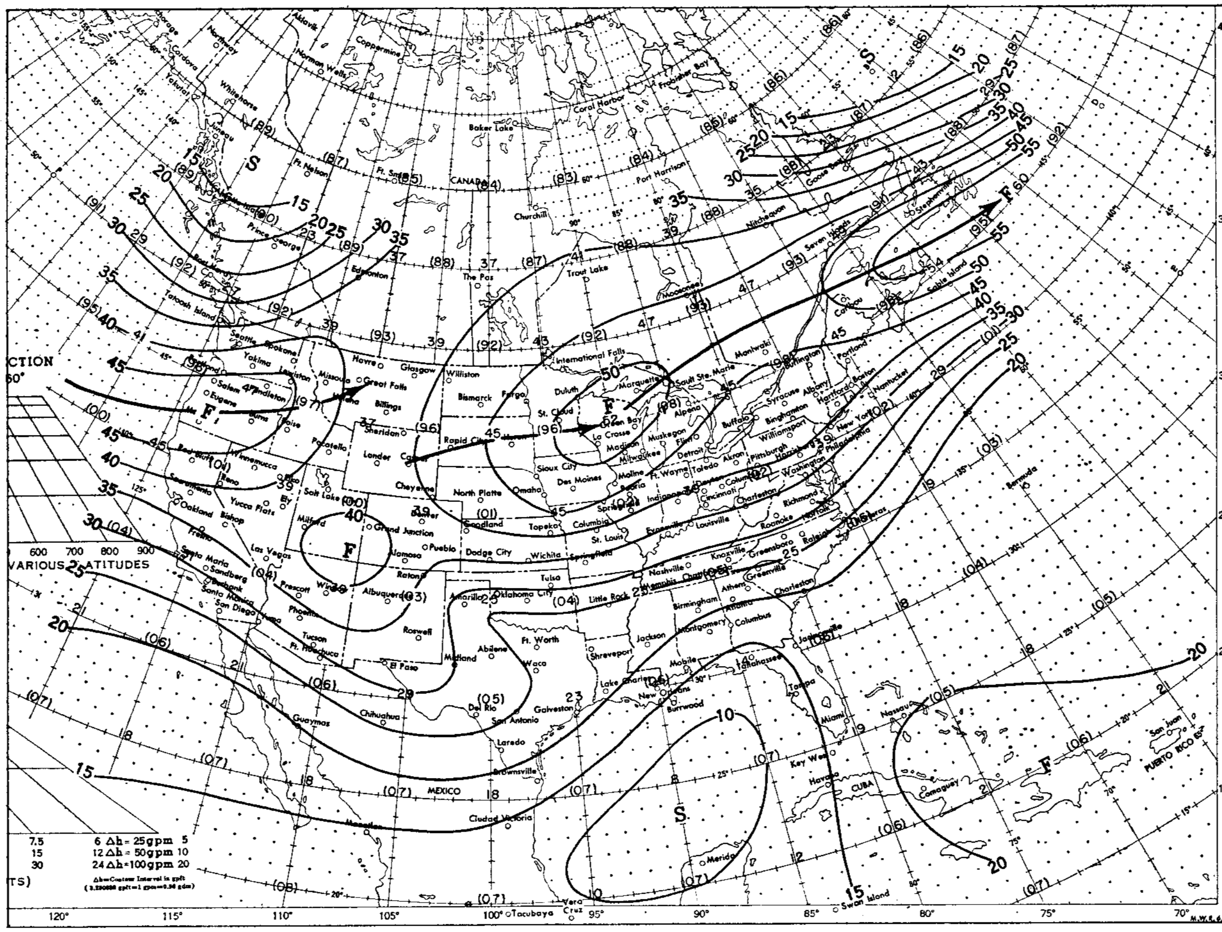

FIGURE 1.—Total (horizontal) geostrophic mean wind speeds (in knots) at the 200-mb. level for June 1957. The numbers in parentheses plotted at standard intersections are the monthly mean 200-mb. heights (in hundreds of feet with first digit omitted) from which the winds were computed. The arrows locate the mean jet streams and are drawn through axes of maximum wind speed. Centers of fast and slow speed are labeled F and S respectively.

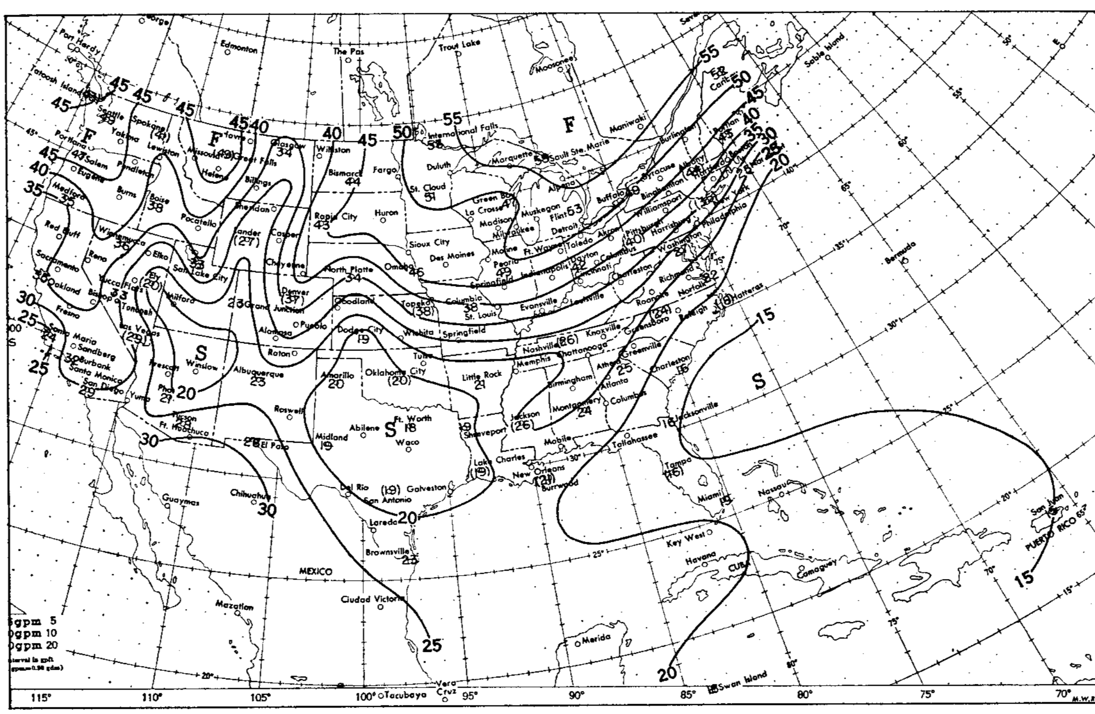

FIGURE 2.—Resultant 200-mb. wind speeds (in knots) for June 1957. Numbers in parentheses are speeds based upon less than 30 days. Centers of fast and slow speed are labeled F and S respectively. All data obtained from *Climatological Data, National Summary*, vol. 8, No. 6, June 1957.

To compare the monthly mean geostrophic and resultant winds, I have taken the June resultant wind speeds at 200 mb. [6], plotted them to the nearest knot in figure 2, and carefully analyzed the field of isotachs. The reader can judge for himself how figure 2 compares with figure 1, which contains the June geostrophic wind speeds from my article on the weather and circulation of June 1957 [7], but reanalyzed in knots instead of meters per second. As expected, the field of geostrophic wind is smoother than the field of resultant winds, which contains numerous small-scale irregularities. Nevertheless, despite the local differences, both wind fields are quite similar in broad-scale aspect. In the eastern half of the United States both figures 1 and 2 show a general poleward increase of wind speed, with maximum speeds along the northern border of the country and minimum speeds along the Gulf coast. In the western half of the United States both figures are more complex, perhaps because of mountain effects, and greater differences are apparent, but here again a general northward increase of wind speed is visible. The primary axis of maximum wind speed or jet stream is clearly delineated in figure 1 around 45° N., except for the area of the Rocky Mountain States (around 110° W.) where the jet axis appears to be split, discontinuous, and poorly defined. On the other hand, it is difficult to delineate any jet axis in figure 2 because of local irregularities in the resultant winds and because of the absence of Canadian and Mexican data.

Space does not permit reproduction of my analyses of the resultant wind speeds for April and May 1957, which have been prepared in the same fashion as figure 2. Like figure 2, these analyses exhibit numerous small-scale irregularities, but on a broad scale they agree with the corresponding geostrophic wind fields.

Table 1 lists resultant wind speeds for the 3 months of April, May, and June 1957 at selected cities in the southern and northern United States. In general the southern cities had maximum wind speeds and were located near the primary jet axis during April or May, while the northern cities had strong winds and were near the jet axis in June. The rapid increase in wind speed from May to June at northern cities in the western United States, as well as the sharp decrease in speed during the same period at the southern cities, was strongly suggestive of the abrupt northward displacement of the primary jet stream from May to June in the western United States mentioned in my original article [7].

TABLE 1.—*Monthly resultant wind speeds (in knots) during spring of 1957 at selected cities in the United States*

Station	April	May	June
SOUTHERN UNITED STATES			
San Diego, Calif	*56	49	29
Tuscon, Ariz	54	*63	28
Brownsville, Tex	*51	44	23
San Antonio, Tex	44	*55	19
Shreveport, La	*53	38	19
NORTHERN UNITED STATES			
Seattle, Wash	32	10	*49
Great Falls, Mont	25	11	*49
Bismark, N. Dak	21	18	*44
International Falls, Minn	39	39	*53
Sault Ste. Marie, Mich	57	*64	59
Caribou, Maine	52	58	*52

*Indicates that station was close to area of maximum resultant wind speeds for the month.

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